



Air quality monitoring system and Smart Environmental platform in the Ports of Balearic Islands

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Ports de Balears

Autoritat Portuària de Baleares

kunak[®]
SENSING ANYWHERE

 **suez**

 **AQUATEC**

27th October 2023

More info at:
www.kunakair.com

Background – Pilot Project

The Port Authority of Balearic Islands (APB) → 2016

To know the port operations IMPACT on the air quality of its ports and MINIMIZE it.

SmartSensPort



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Universitat de les Illes Balears

- Study the possible use of **sensors** and design a **monitoring network** to aid decision-making.
- Deployment of 8 real-time air quality measurement points in the port of Palma (2017-2018).
- Sensor networks are a good alternative to monitor environmental variables in ports and help make data-driven decisions.



Air quality instruments



Reference & Equivalent instruments

- ✓ High data quality
- ✓ Regulated and certified
- ✗ One pollutant per instrument
- ✗ High costs
- ✗ Limited spatial resolution

Professional sensor-based air quality stations

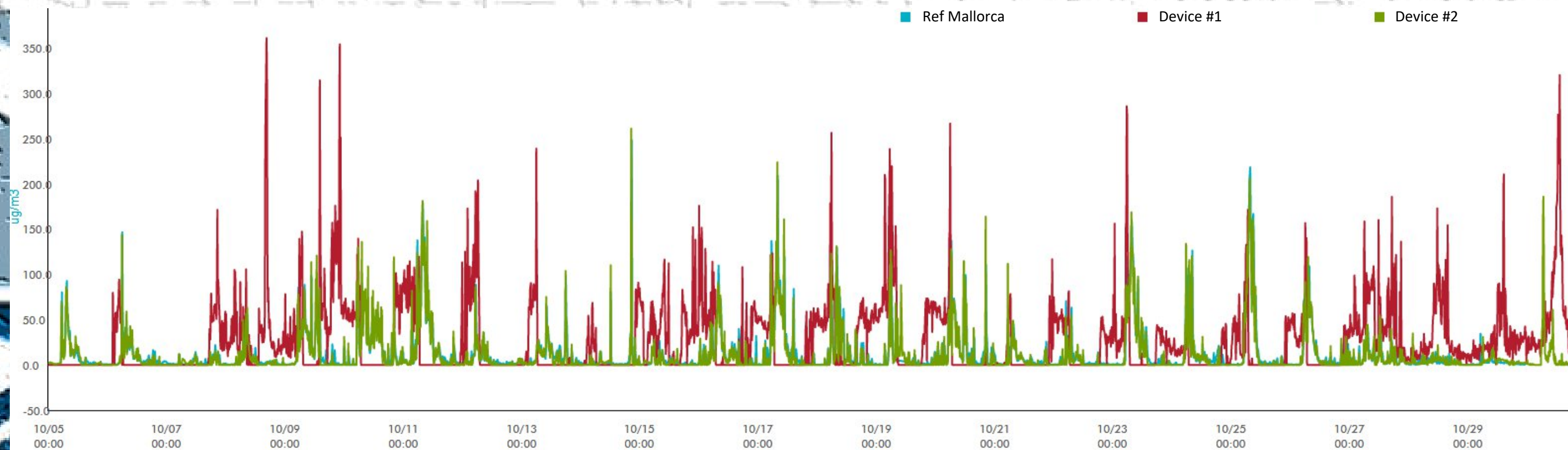
- ✓ Accurate data
- 🔄 Ongoing certification
- ✓ Several pollutants per instrument
- ✓ Cost-effective
- ✓ High spatial resolution

Low-cost air quality sensors

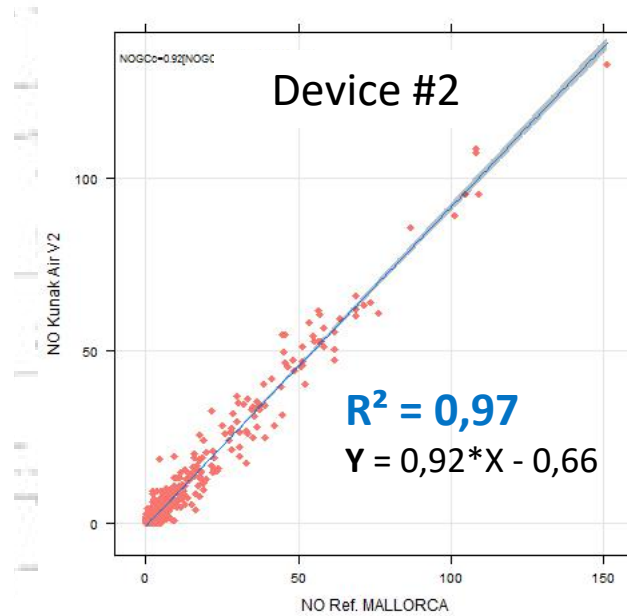
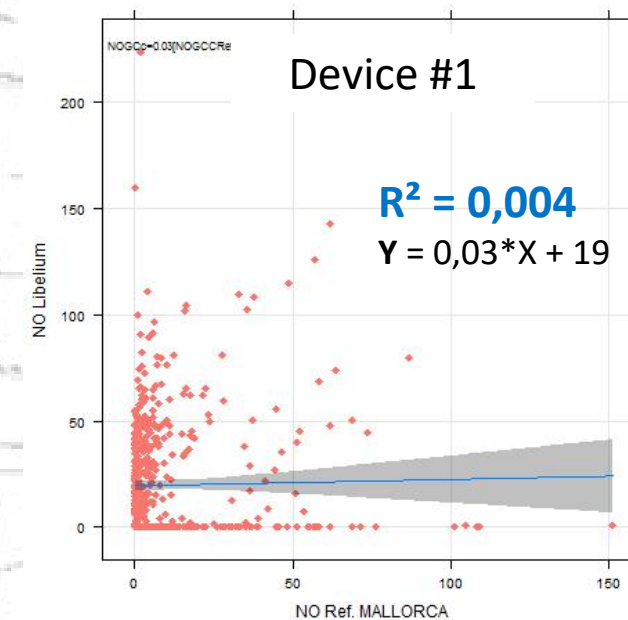
- ✗ Poor data quality
- ✗ Non-regulated
- ✓ 1 - 2 pollutants per instrument
- ✓ Very low-cost
- ✓ High spatial resolution

Air quality instruments

Evaluation of different air quality sensor-systems in 2018



- Importance to select a proper AQ sensor system → highest accuracy for pollutants, easy installation and maintenance, etc.
- Establish technical specifications required for the project



Air quality network in APB Ports – Phase 1

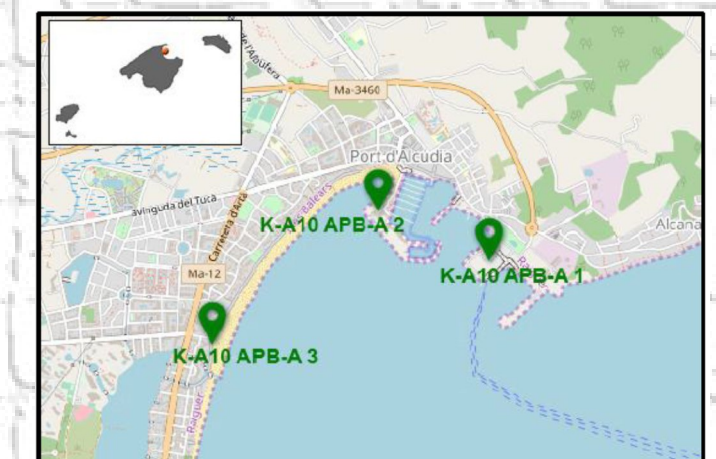
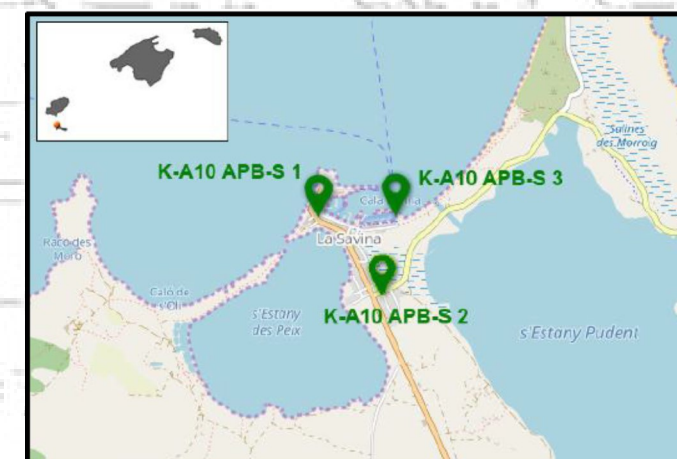
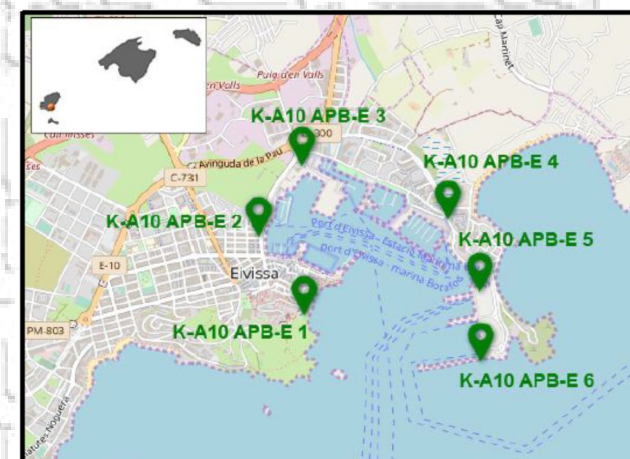
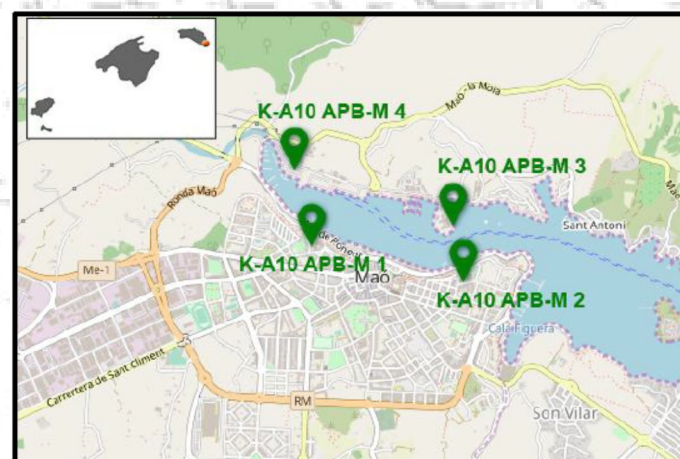
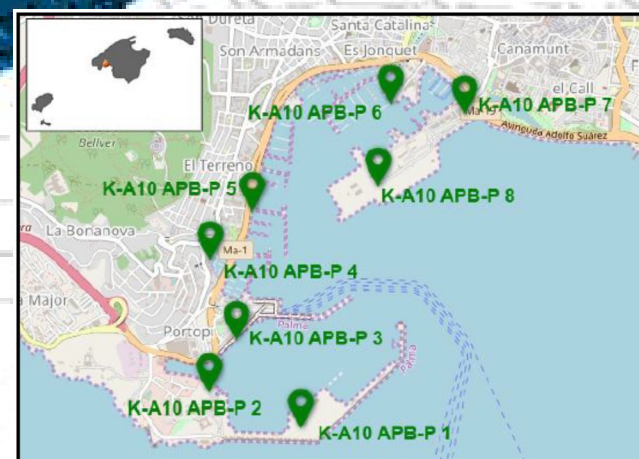
The UIB → technical study for the installation of sensors.

Deployment in 2019



**25 points –
50 KUNAK AIR V2
DEVICES**

CO, NO, NO2, O3, SO2, PMs
Anemometer
Pluviometer
Noise Level



Air quality network in APB Ports – Phase 1

- Detect impacts, analyse them and identify possible causes.
- Management and analysis of the information carried out via a web-based platform.

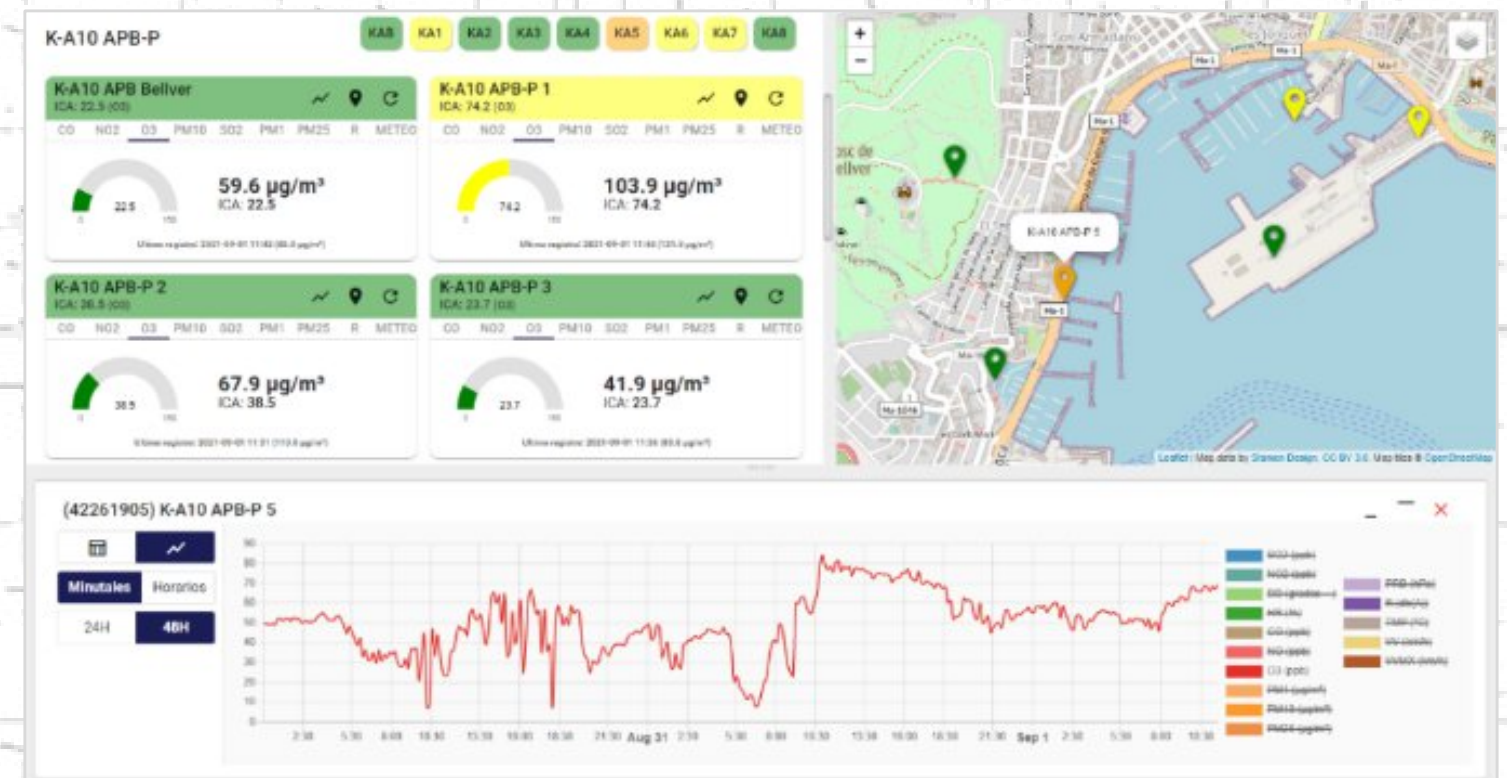
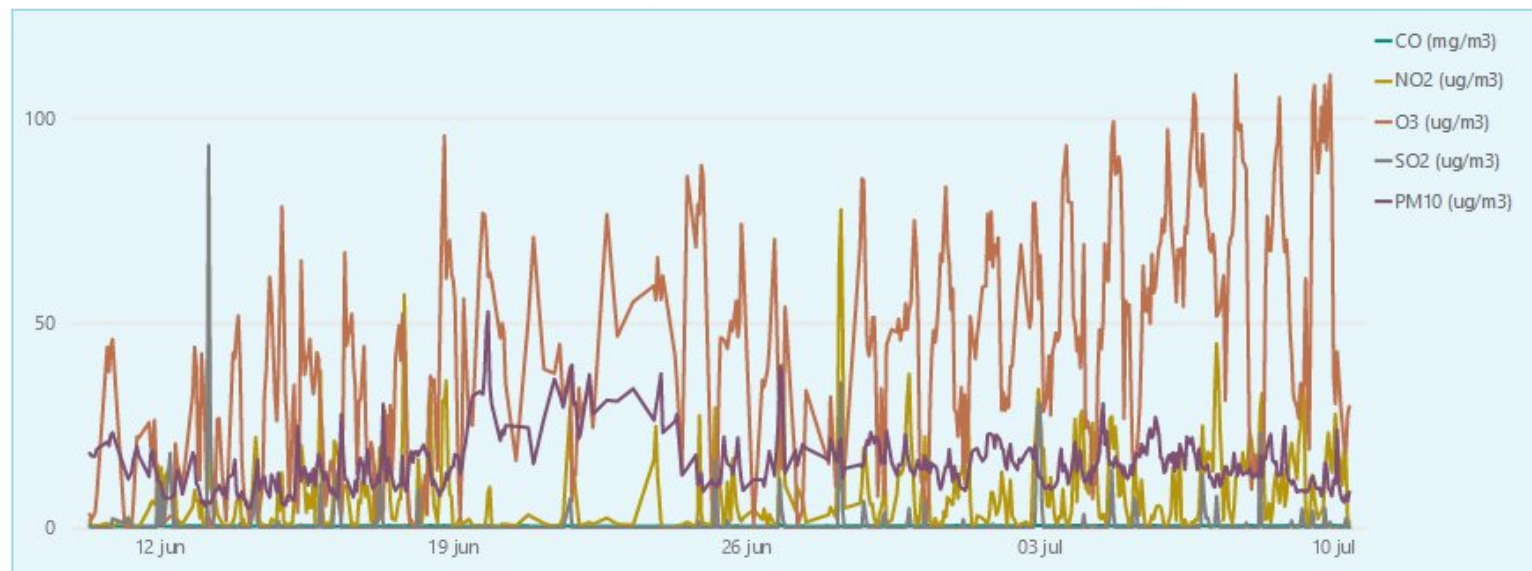


Índices de calidad del aire (última media horaria calificada*):

CO Monóxido de Carbono	NO2 Dióxido de Nitrógeno	O3 Ozono	SO2 Dióxido de Azufre	PM10 Partículas 10	LAeq Ruido
0.44	1.39	29.55	0.00	8.68	64.46
mg/m3	ug/m3	ug/m3	ug/m3	ug/m3	dB(A)
● Excelente	● Excelente	● Excelente	● Excelente	● Excelente	---

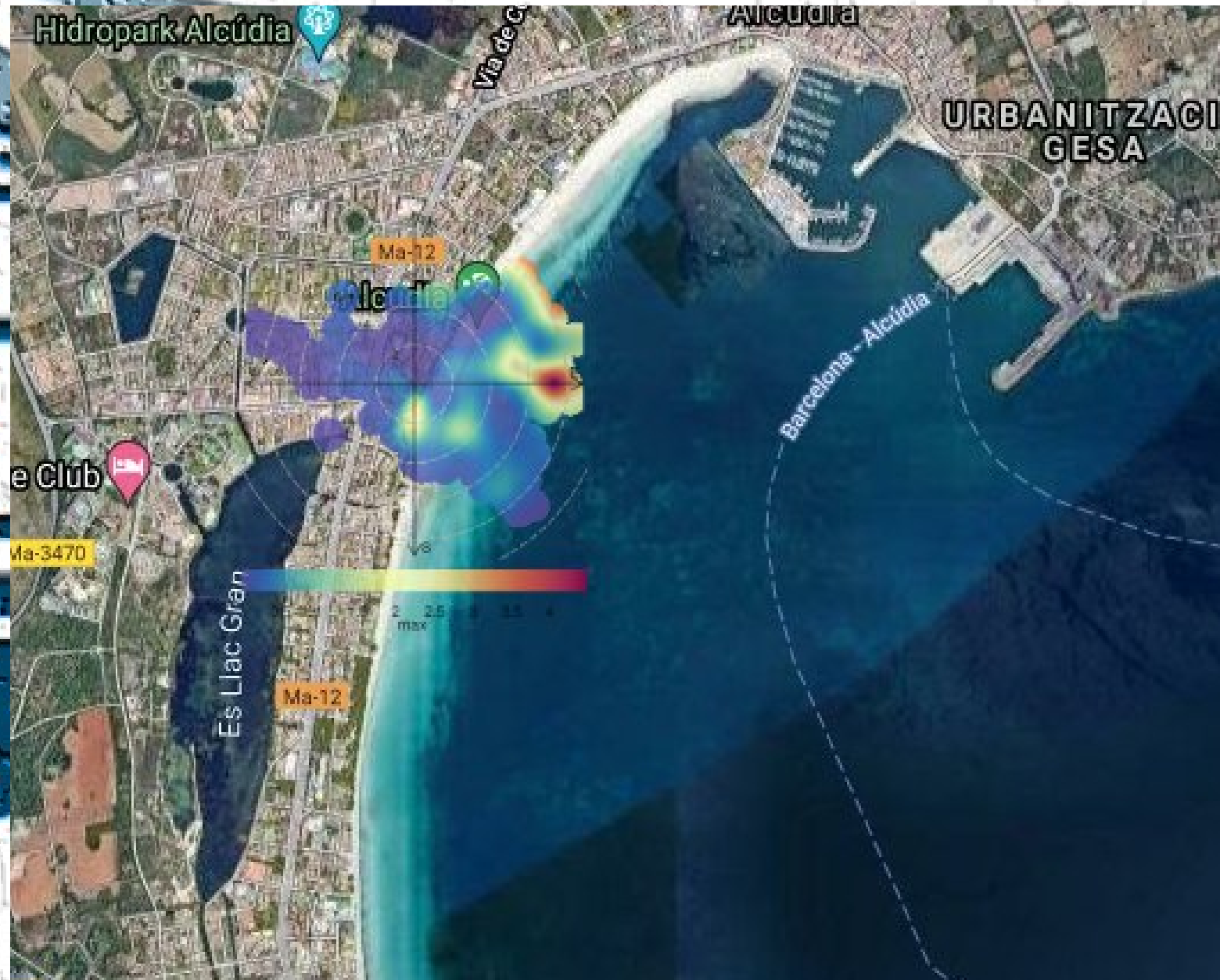
* Fuente página web <http://www.caib.es/s/acmicrofont/archivopub.do?ctrl=MCRST145Z184843&id=84843> del Govern Balear

Índices de calidad del aire (medias horarias del último mes):

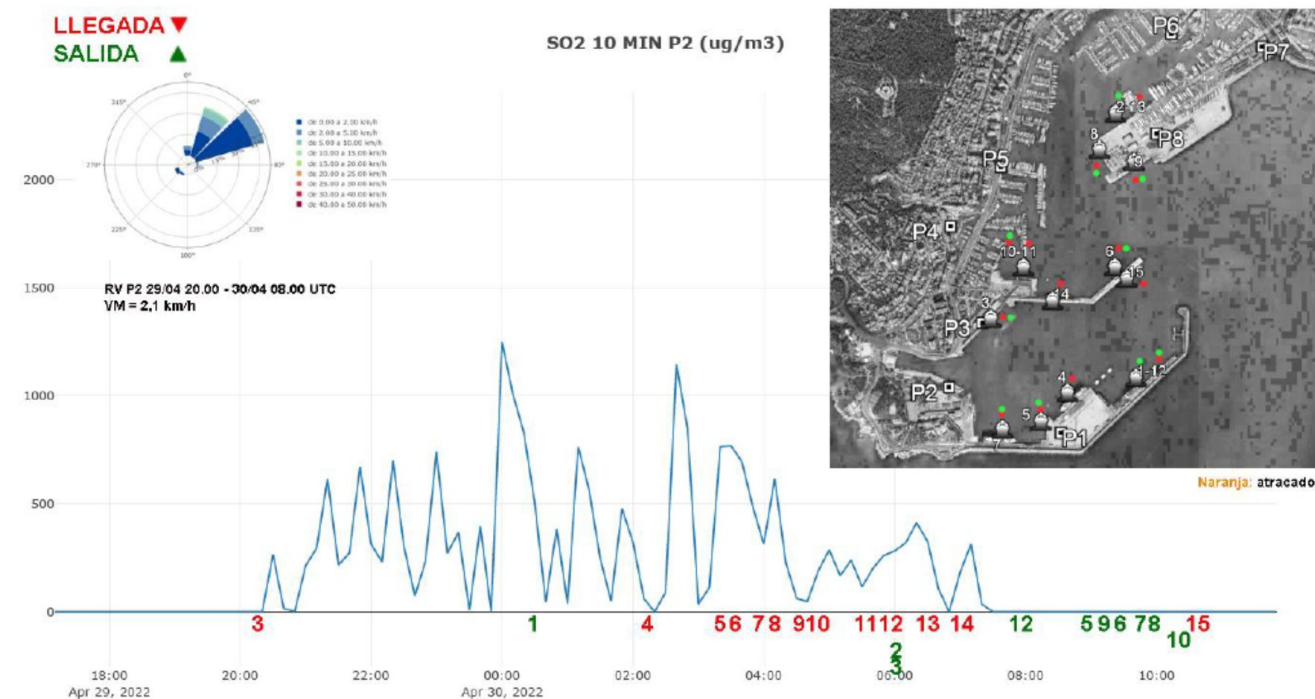


Air quality network in APB Ports – Phase 1

Relationship between SO2 concentration and ships



id	Buque	llegada UTC	salida UTC	CÀrrega	Alineació	Consignatario	Tipo buque
1	ABSA UNO	29/04/2022 1:50	30/04/2022 0:35	P185	MUELLE DE LA 2 ALIN. DEL DIQUE DEL OESTE	ESTELA SHIPPING PALMASA	CONVENCIONAL
2	CIUDAD DE GRANADA	29/04/2022 10:08	30/04/2022 5:55	P065	MUELLE ADOSADO	GRIMALDI LOGISTICA ESPAÑA, SL	FERRY CARGA/PASAJE
3	ELEANOR ROOSEVELT	29/04/2022 20:18	30/04/2022 5:55	P145	MUELLE PARAÍRES	BALEARIA EUROLINEAS MARITIMAS S.A.U.	PASAJE RAPIDOS
4	AIDACOSMA	30/04/2022 2:18	30/04/2022 20:25	P181	ALIN. NORTE DE LA PLATAFORMA	INTERCRUISES SHORESIDE & PORT SERVICES	CRUCEROS TURISTICOS
5	HEDY LAMARR	30/04/2022 3:13	30/04/2022 8:51	P180	ALIN. OESTE DE LA PLATAFORMA	BALEARIA EUROLINEAS MARITIMAS S.A.U.	FERRY CARGA/PASAJE
6	TENACIA	30/04/2022 3:26	30/04/2022 9:23	P132	M. 2ª ALIN. PONIENTE NORTE	TRANSPORTES Y CONSIGNACIONES MARITIMAS BALEAR SAU	FERRY CARGA/PASAJE
7	ABEL MATUTES	30/04/2022 3:54	30/04/2022 9:38	P175	MUELLE DE LA 1 ALIN. DEL DIQUE DEL OESTE	BALEARIA EUROLINEAS MARITIMAS S.A.U.	FERRY CARGA/PASAJE
8	CIUDAD DE PALMA	30/04/2022 4:03	30/04/2022 9:47	P075	TESTERO MUELLES COMERCIALES	GRIMALDI LOGISTICA ESPAÑA, SL	FERRY CARGA/PASAJE
9	CIUDAD DE ALCUDIA	30/04/2022 4:32	30/04/2022 9:08	P085	1ER. TRAMO EXT MLLES CIALES.	GRIMALDI LOGISTICA ESPAÑA, SL	FERRY CARGA/PASAJE
10	GNV BRIDGE	30/04/2022 4:45	30/04/2022 10:26	P120	AMPLIACION MUELLE PONIENTE NORTE	TRANSPORTES Y CONSIGNACIONES MARITIMAS BALEAR SAU	FERRY CARGA/PASAJE
11	SILVER MOON	30/04/2022 5:31	30/04/2022 15:55	P120	AMPLIACION MUELLE PONIENTE NORTE	A PEREZ Y CIA SL	CRUCEROS TURISTICOS
12	HYPATIA DE ALEJANDRIA	30/04/2022 5:52	30/04/2022 8:11	P185	MUELLE DE LA 2 ALIN. DEL DIQUE DEL OESTE	BALEARIA EUROLINEAS MARITIMAS S.A.U.	FERRY CARGA/PASAJE
13	GUBAL TRADER	30/04/2022 6:37	30/04/2022 18:27	P065	MUELLE ADOSADO	GRIMALDI LOGISTICA ESPAÑA, SL	ROLL ON ROLL OF C. RODADA
14	NAUTICA	30/04/2022 6:54	30/04/2022 17:03	P140	M. 1ª ALIN. PONIENTE SUR	INTERCRUISES SHORESIDE & PORT SERVICES	CRUCEROS TURISTICOS
15	NORWEGIAN EPIC	30/04/2022 10:33	30/04/2022 18:00	P142	M. 2ª ALIN. PONIENTE SUR	INTERCRUISES SHORESIDE & PORT SERVICES	CRUCEROS TURISTICOS



Air quality network in APB Ports – Phase 2

Improvements:

1. Relocations of some points of the network
2. New version → **Kunak Air PRO**
25 devices (5 gases + PM in one instrument)
3. New parameters to measure
 - VOC sensors
 - Rain gauge in each port
 - Anemometer in each location



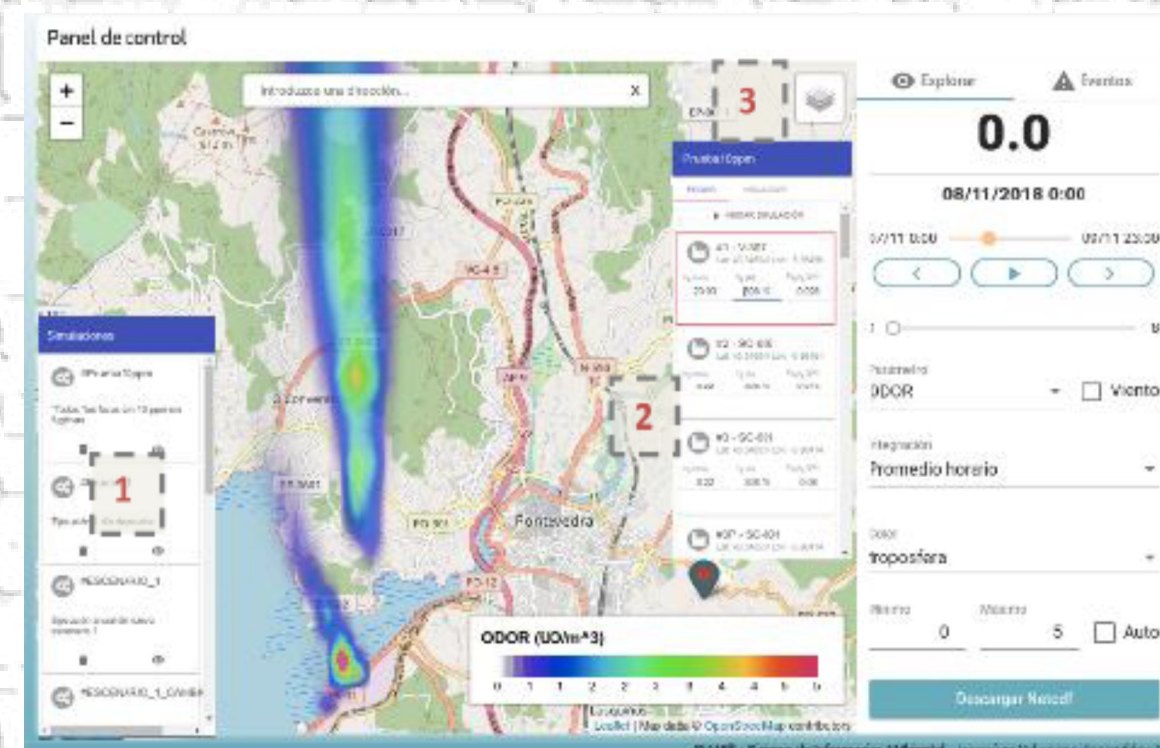
Air quality network in APB Ports – Phase 2

Improvements:

4. New Kunak Air Mobile



5. Integration of the monitoring system and simulation tools in the Smart Environmental Platform.





Data quality of Kunak Air PRO

- US EPA HONORARY MENTION in Wildland Fire Sensors Challenge

(<https://www.epa.gov/air-research/winners-wildland-fire-sensors-challenge-develop-air-monitoring-system-prototypes>)

- MOST ACCURATE MULTI-CONTAMINANT SENSOR at the AIRLAB Microsensors Challenge 2021, an international workshop on air quality solutions organised by AIRPARIF.

(<https://airlab.solutions/en/projets/challenge-microcapteurs-edition-2021-90>)

International
Air Quality Sensors
Workshop
AIRLAB Challenge Awards



• Most accurate multi-pollutant sensor:

Outdoor: **KUNAK Air Pro** (Spain )

- MCERTS Certified Products: Indicative Ambient Particulate Monitors

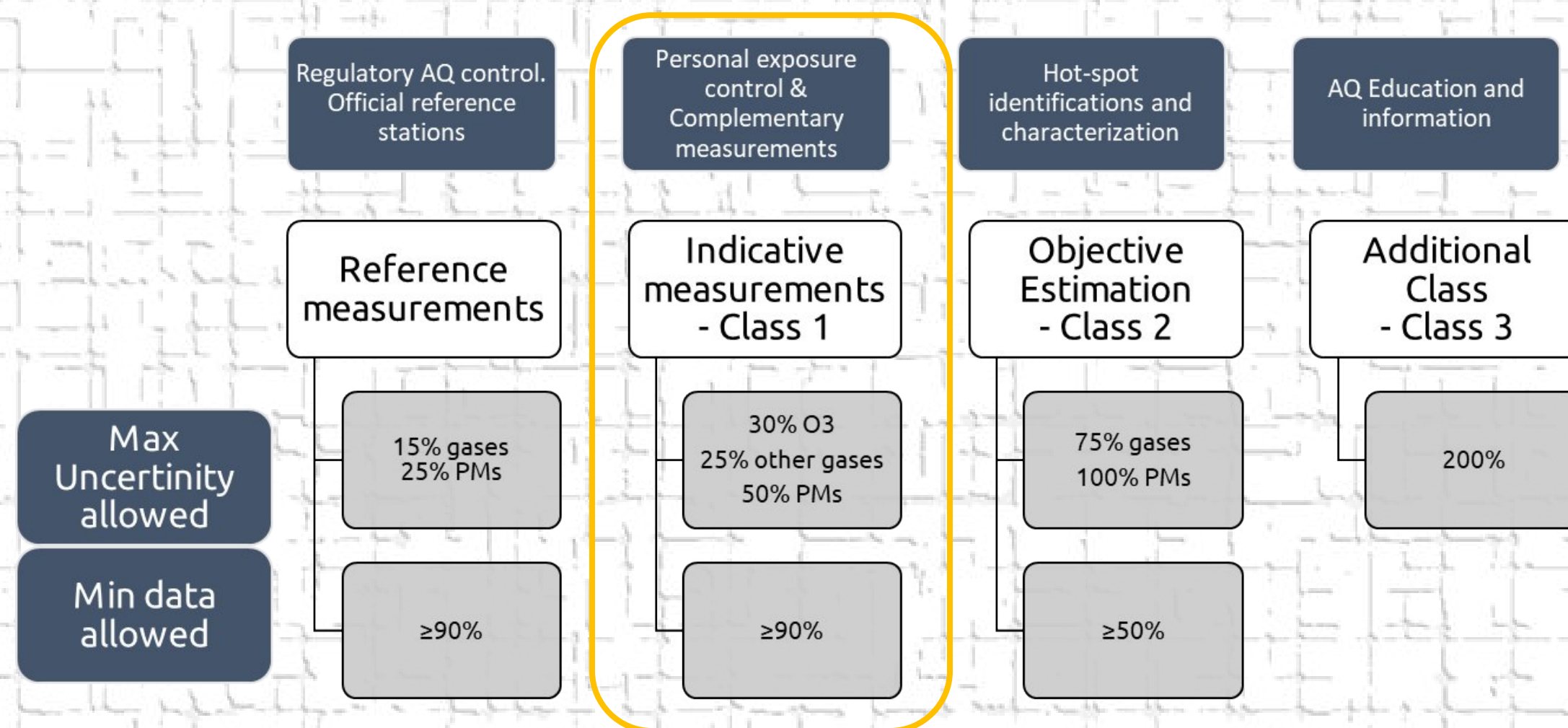
(<https://www.csagroup.org/en-gb/services/mcerts/mcerts-product-certification/mcerts-certified-products/mcerts-certified-products-indicative-ambient-particulate-monitors/>)



Data quality of Kunak Air PRO

UNE-CEN/TS 17660-1:2021 “Air quality - Performance evaluation of air quality sensor systems - Part 1: Gaseous pollutants in ambient air”

- ✓ Class 1 sensors: Indicative measurements aligned with the objectives of AQ Directive 2008/50/CE.
- ✗ Class 2 & Class 3 sensors: Do not comply with the objectives of AQ Directive 2008/50/CE.



Data quality of Kunak Air PRO

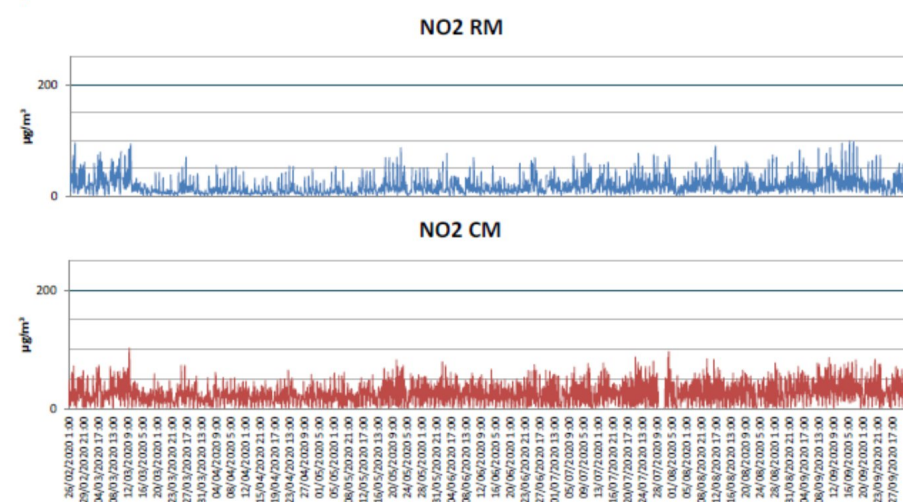
Kunak Air comparisons against reference stations

Test de Equivalencia:

Funci3n de calibraci3n	RM = 1,023*CM - 4,840	
Incertidumbre relativa expandida (a 200 µg/m ³)	16,1 %	*Satisfactoria

*Incertidumbre m3xima: 25% (mediciones indicativas, R.D. 102/2011)

Series temporales:

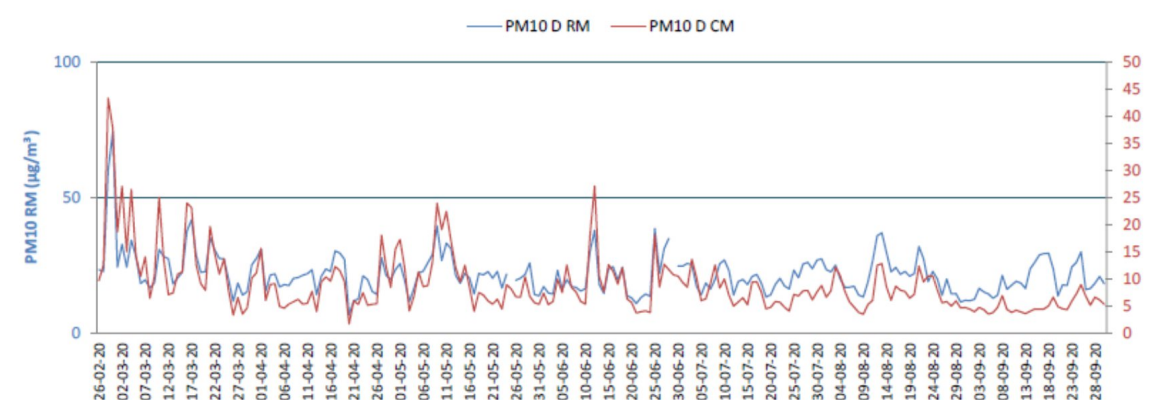


Test de Equivalencia:

Funci3n de calibraci3n	RM = 1,442*CM + 8,845	
Incertidumbre relativa expandida (a 50 µg/m ³)	22,7 %	*Satisfactoria

*Incertidumbre m3xima: 50% (mediciones indicativas, R.D. 102/2011)

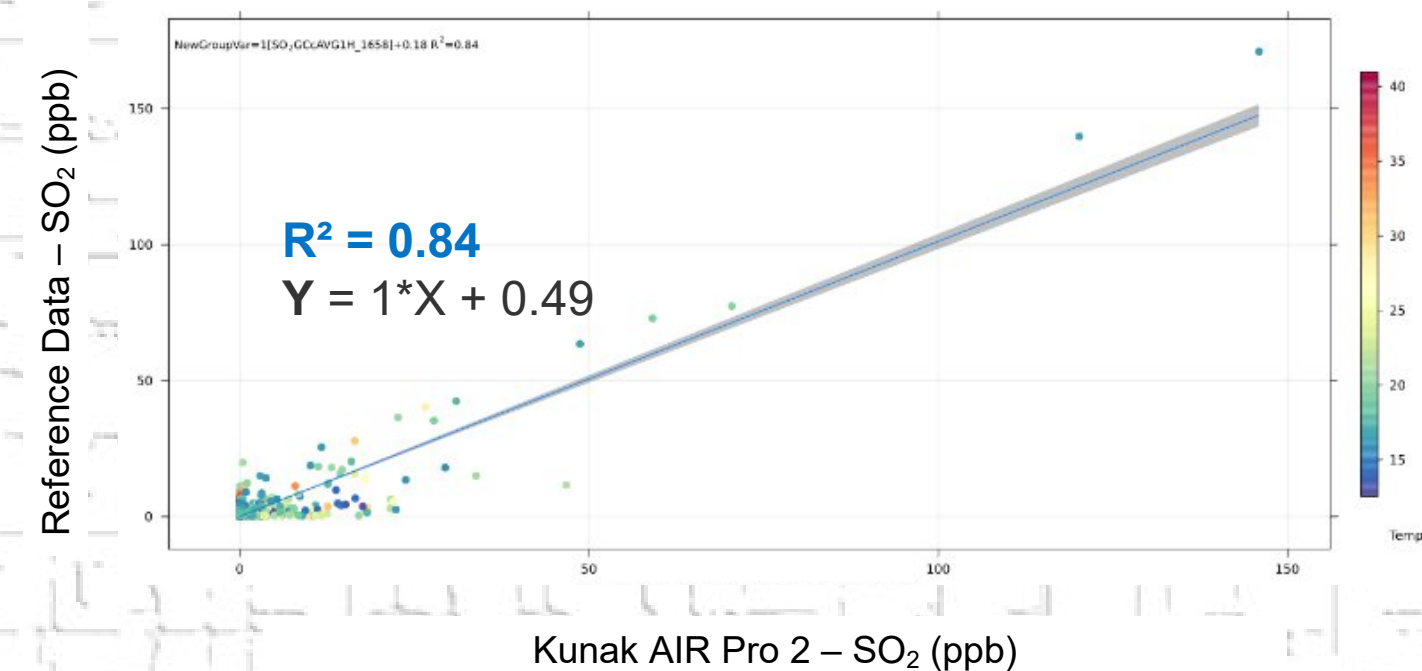
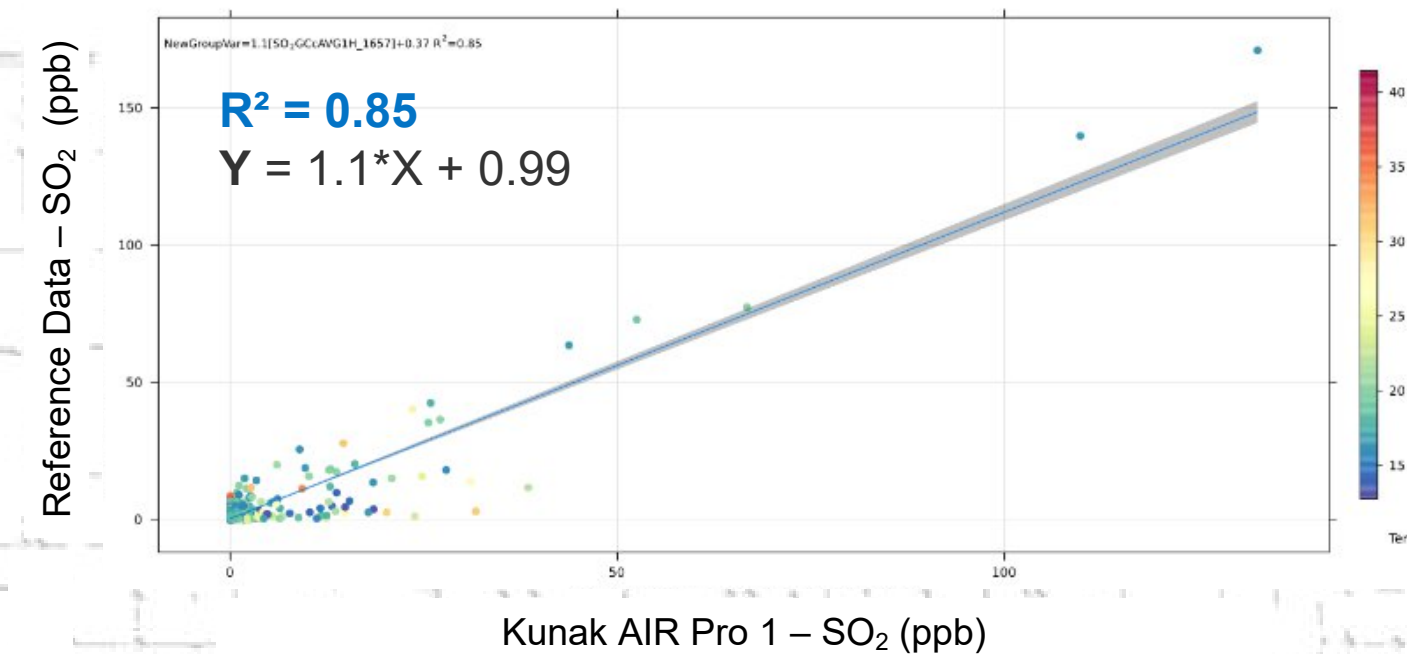
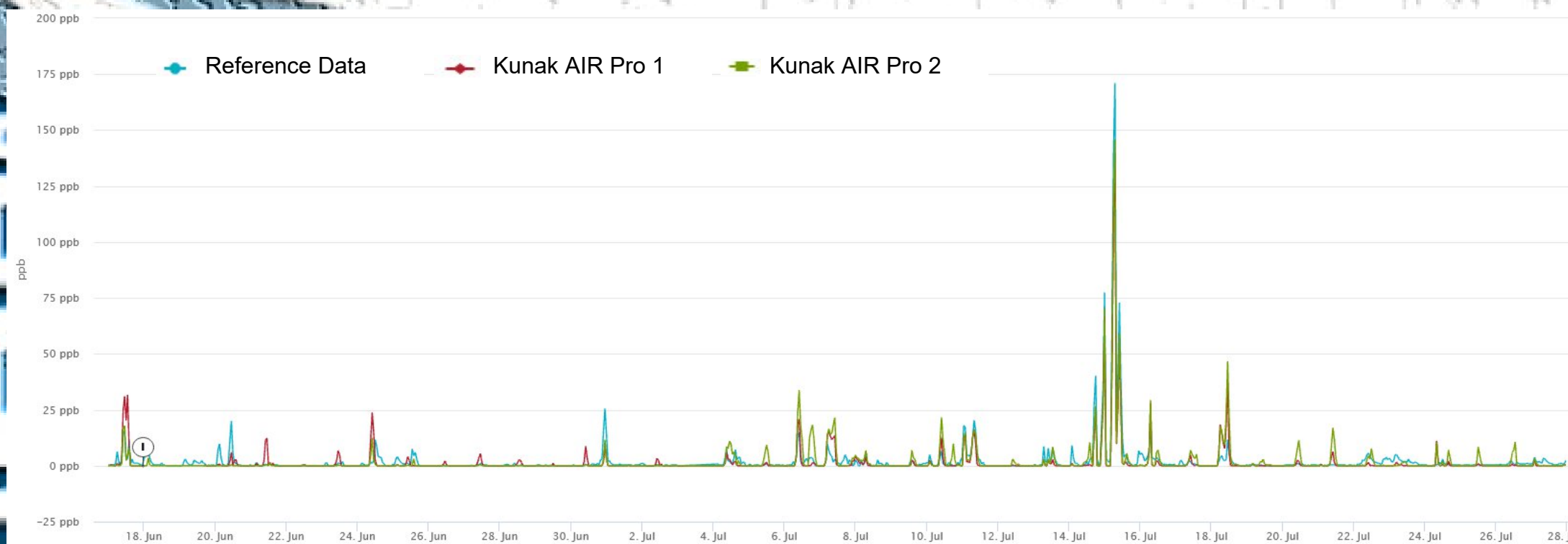
Series temporales:





Data quality of Kunak Air PRO

Kunak Air comparisons against reference stations



Device	R ²	MAE (ppb)	U(exp) (<25%)	N > LV
Kunak AIR Pro 1	0.85	1.46	24.86 %	1
Kunak AIR Pro 2	0.84	1.55	5.91 %	1

Award Air Quality Exhibition 2022



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BEST AIR QUALITY NETWORK MONITORING



AQE
AIR QUALITY & EMISSIONS
12TH & 13TH OCTOBER 2022
TELFORD, UNITED KINGDOM

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